II. REMARKS

A. Amendment to the Specification

This amendment corrects an error in the amendment filed 9/18/2002. In that amendment it was stated that:

> My review of the file for this application shows (1) that application Serial No. 09/307,988 filed 5/10/99 claimed priority to application Serial No. 08/816,097, filed March 14, 1997 and application Serial No. 08/816,097, filed March 14, 1997 and (2) the official filing receipt does not list the priority claim to application Serial No. 08/816,097, filed March 14, 1997.
>
> In response (1) I have requested a corrected official filing receipt and (2) filed this amendment to comply with the requirements of 35 USC 120.
>
> I also not that the original claim in this application to priority to application Serial No. 08/816,097, filed March 14, 1997 was under 35 USC 121, i.e., divisional status. However, (1) 08/816,097 is abandoned and therefore divisional status provides no benefit to this application and (2) a new claim set is present in this application. Accordingly, the applicants no longer claim divisional status under 35 USC 121 and only claim priority to 08/816,097 under 35 USC 120.

However, the actual amendment filed 9/18/2002 inadvertently specified 08/816,097, filed March 14, 1997 where it should have specified "08/549,385, filed October 27, 1995, now USP 5,782,822." The present amendment corrects that typographical error.

B. No Petition Required to Correct Error

During a telephone consultation with Petitions Exam. Patricia Ball on April 28, 2008, the undersigned counsel, Hahl, was advised that no petition regarding a late priority claim is required to correct this error. Examiner Ball indicated that the amendment filed 9/18/2002 clearly did not mean to delete the original reference to parent Appl. Ser. No. 08/549,385, but omitted that application number through a typographical error.

In addition, the previously filed request for a corrected filing receipt, and attorney PAIR, correctly list the priority claims to both 08/549,385 and 08/816,097.

C. **Response to Claim Rejections**

Claims 61-63, 67-75, 77-80 and 90-96 stand rejected under 35 USC 103(a) as being unpatentable over Lin in view of Tang et al. This rejection is not new, and was addressed in the Appeal Brief.

Several basic factual inquiries must be made to determine obviousness of claimed subject matter. In particular, "the scope and content of the prior art [are] to be determined...[and] the level of ordinary skill in the pertinent art resolved." Graham v. John Deere Co., 383 U.S. 1, 17, 148 USPQ 459, 467 (1966).

To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation to modify the reference, or to combine references' teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference must teach or suggest all of the limitations defined by the claims. In re Vaeck, 20 USPQ 2d 1438 (Fed. Cir. 1991).

If the proposed modification of the prior art would change the principle of operation of the prior art, then the teaching of the reference is not sufficient to render the claims prima facie obvious. In re Ratti, 123 USPQ 349 (CCPA 1959). Moreover, a rejection must be based on substantial evidence. In re Gartside, 203 F.3d 1305, 1316, 53 USPQ2d, 1769, _____ (Fed. Cir. 2000).

The rejection of claims 61-63, 65-80 and 90-96 under 35 USC 103 (a) in view of the Lin patent and further in view of the Tang article is improper and should be reversed because no facts suggest an idler beam pulse having a wavelength of between about 2.75 and about 3.0 microns as defined by independent claims 61 and 90, or an idler beam pulse having a wavelength of between 2.9 and 3.0 microns as defined by independent claim 80.

In support of the rejections, the examiner states that:

> Claims 61-63, 65-80, and 85-96 [sic. 90-96] are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin in view of Tang et al. Lin teaches performing corneal sculpting with radiation in the 2.5-3.2 micron range generated by an OPO with pulse width in the 1-40 nsec range. Tang et al[.] teach producing radiation in the range of Lin using a CPM KTP OPO pumped at about 1 micron, the pump thresholds are discussed as 0.5 mj corresponding to 30 kw peak power and 17 MW/cm^2. To produce 0.5 mj with a 30 kw pulse requires a pulse width of 17 nanoseconds to [sic; . To] produce a power density of 17 MW/cm^2 with 30 Kw pulse yields (assuming a circular beam cross section) a beam radius of 563

microns which is well in excess of eight times the diffraction limit of the single mode beam. It would have been obvious to the artisan of ordinary skill to employ the OPO of Tang et al[.] in the method of Lin, since the enables effective tuning in the desired range as taught by Tang et al; to employ a mirror that transmits the pump pulse at a forty five degree angle thereto since the [sic; that] does not manipulatively affect the method and is notorious in the art; to tune the output to be in the 2.75-3.0 micron, since Lin gives no indication that this portion of Lin's range should be avoided, the claimed range is not critical; and wavelengths near 3 microns are notoriously useful for surgery, official notice of which is hereby taken; to increase the power of the pump beam by increasing the energy of the pump, since this would reduce the thermal damage to the non-linear material compared to increasing the pulse width official notice of which is hereby taken [sic ;] and to transmit pump radiation exiting the crystal to a second KTP crystal and interlace the resulting idlers, since these are equivalents, provide no unexpected result, and are known configurations in the art, official notice of which is hereby taken thus producing a method such as claimed. [Office action page 2 line 11 to page 3 line 10; interpolation supplied.]

The applicants submit that this rejection is improper and should be reversed because it is not supported by substantial evidence.

1. **Lin Patent**

The relevant teachings of the Lin patent are discussed below.

Column 9 lines 31-42 in Lin states that:

> The basic laser also includes a mid-IR (2.5-3.2 microns) laser generated from optical parametric oscillation (OPO) using a near-IR laser (such as Nd:YAG or Nd:YLF, flash-lamp or diode-pumped) as the pumping sources and KTP or BBO as the frequency conversion crystals. The OPO laser has advantages over the Q-switched Er:YAG laser, including higher repetition rate (10-5,000 Hz) and shorter pulse width (1-40 n.s.). These advantages provide faster surgical procedure and reduced thermal damage on the ablated corneal tissue. Typical energy per pulse of the OPO laser is (0.1-10) mj. Greater detail on OPO was published by the inventor in Optical Communications, vol. 75, p. 315 (1990).

Claim 18 in Lin states that:

> 18. A method of performing corneal refractive surgery by reshaping a portion of the corneal surface in accordance with claim 1 in which the step of controlling said scanning mechanism includes controlling said scanning to scan a pattern of radial aligned slits of fixed area using a laser beam capable of photoablating corneal tissue for laser radial keratectomy.

Lin is silent regarding phase matching.

Morever, Lin does not enable an OPO laser system for wavelengths in the 2.75 to 3.0 μm range. Lin cites at column 9 lines 41-42 to "Optical Communications", vol. 75, p. 315 (1990) for details on OPO. However, that paper "report[s] the first demonstration of a tunable mid-IR (1.8 - 2.4 μm) coherent source." See the abstract. Lin's reported 1.8 - 2.4 μm wavelengths are outside of the 2.75 -3.0 μm and 2.9-3.0 μm wavelength ranges claimed herein. Lin contains no disclosure enabling OPO in the 2.75 - 3.0 μm wavelength range.

2. **Tang et al.**

Tang et al. is a one page paper. Tang et al. discloses theoretical calculations (solid lines in figures 1a, 1b, and 2 and some experimental data (series of data points in figure 1a and two points in figure 2). Specifically, Tang et al.'s left hand column, second paragraph, starting "An initial theoretical comparison....") indicates that solid lines are theoretical predictions, not data. Moreover, Tang et al.'s caption for figure 2 indicates that symbols of a circle, a diamond, a plus sign, and a capital X represent data thereby implying that the solid lines represent the theoretical calculations.

Furthermore, the caption for figure 1 states "Experimental data is also shown" implying that the solid lines are theoretical predictions and the set of square and triangular symbols in figure 1a represent data. In addition, Tang et al.'s right hand column lines 14-15 states that "Measured signal/idler wave tuning is shown also in Fig. 1" apparently referring to the square and triangular symbols shown in figure 1a.

Tang et al. center column last full paragraph lines 1-10 states that:

> To compare and contrast the CPM device with the NCPM geometry, two 25-mm-long KTP crystals cut at ... , cut at $\theta = 90°$, $\phi = 0°$ and $\theta = 63.4°$, $\phi = 0°$ have been employed in our experiments. In the latter case, the calculated signal and idler wavelength pair at normal incidence are 1.714 μm and 2.69 μm respectively. The corresponding tuning rate about this point for the signal wave is 17.1 nm.deg^{-1}.

The caption for figure 1 states that the pump wavelength was 1.047 μm.

Tang et al. figure 2 shows that the experimental data points are for data obtained near the intersection of the theoretical predictions for the threshold pump power and threshold intensity. As can be seen in figure 2, this intersection defines a relative minima of the product of the threshold pump power and threshold intensity, indicating to one of ordinary skill in the art

criticality to that pair of values. Figure 1a shows data only for a two or three degree range of θ about 63.4 degrees, implying to one of ordinary skill in the art that no OPO lasing occurred outside of that range. That conclusion is consistent with the well known fact that non critical phase matching is very sensitive to the value of the angle θ.

Tang et al. does not state the experimental value of the conversion efficiency to the idler beam. Tang et al. discloses (right hand column lines 10-14) a thirty percent conversion efficiency to the signal beam. Presumably, the conversion efficiency to the idler beam was lower than the conversion efficiency to the signal beam since Tang et al. cites signal beam conversion efficiency, not idler beam conversion efficiency.

The examiner asserts that "to increase the power of the pump beam by increasing the energy of the pump, since this would reduce the thermal damage to the non-linear material compared to increasing the pulse width official notice of which is hereby taken," thereby admitting that "power of the pump beam", "energy of the pump," and "the pulse width" were known factors and limitations relating to "thermal damage to the non-linear material." This application also discloses the criticality of limiting the pump power in order to avoid destroying the optics. See page 3 line 18 to page 4 line 2 and page 8 lines 17-22. Tang et al. does not disclose any pump pulse power greater than 5 mj. This would have suggested to one of ordinary skill in the art (1) that pulses greater than 5 mj would have damaged Tang et al.'s optics and (2) that 5 mj pump pulses were the largest pump pulse energy Tang et al. believed to be usable without damaging their optics.

From the foregoing, one skilled in the laser arts would have concluded that Tang et al.'s maximum idler pulse generated by a KTP crystal having θ about 63.4 degrees, would have had had an energy of less than 1 mj at a wavelength of 2.69 μm. Moreover one skilled in the laser arts would have known (1) that the idler pulse energy would fall to zero as θ was increased to 65 or 66 degrees, by visual extrapolation the data in figure 1a, and (2) t hat the idler beam wavelength would concurrently increase from 2.69 μm to about 2.8 μm. See data in figure 1a. Based upon the foregoing, one skilled in the art would not have been led to believe that Tang et al.'s non critically phase matched laser system could produce anywhere near 1 mj of energy in idler beam pulses at or above a wavelength of 2.75 μm. For the same reasons, one skilled in the art would not have been led to believe that Tang et al.'s non critically phase matched laser system

could function to produce an idler beam wavelength between about 2.90 and 3.0 µm.

This application discloses that "a desired laser source for this application would have an output energy up to 30 mj" for a surgical laser system operating around 2.94 µm. Page 3 lines 16-17. In addition, the Summary of the Invention section states that the "laser beam comprises ... pulses ... with an energy greater than 1 mj...", thereby suggesting to the reader that the inventors believed that a minimum useful idler beam pulse energy was "<u>greater than</u> 1 mj."

These statements are evidence supporting the conclusion that there would be no motivation to use a system limited to generating less than 1 mj per pulse. At best, Tang et al.'s laser might be capable of lasing at 2.75 µm, but with far less energy per pulse than 1 mj. For these additional reasons, the person of ordinary skill in the art would <u>not</u> have been motivated to try Tang et al.'s system to generate a wavelength above 2.75 µm. Therefore, the rejections relying upon the combination of the Lin and Tang et al. references are improper and should be reversed.

3. **Lin in view of Tang et al.**

There is no motivation to modify Lin in view of Tang et al. because Tang et al. does not disclose a system useful for surgery. In this regard, the examiner's assertion that there is no wavelength criticality is incorrect. This application and the prior art point out that there is an absorption maxima at a wavelength of 2.94 µm caused by the existence of the OH bond, and therefore there is an absorption maxima at 2.94 µm in tissue. In fact Dr. Telfair indicated that the absorption drops sharply outside of the claimed range. He indicated that the coefficient of absorption of tissue decreases by about an order of magnitude from its peak value at 2.94 as compared to its value above the upper claimed limit of 3.0 µm. Similarly, he indicated that the coefficient of absorption decreases by a factor of 2 from the peak value at 2.94 µm to a value at 2.90 µm, and decreases further as the wavelength decreases. Neither Lin nor Tang et al. provide an enabling disclosure of an OPO laser system that could generate laser radiation at 2.94 or in the 2.90 to 3.0 µm range. Given the extrapolated drop off in power with increasing wavelength suggested by Tang et al. and the knowledge in the art of reduced tissue absorption away from 2.94 µm, Tang et al. provided no motivation to use the non critically phase matched OPO laser as the OPO laser suggested by Lin. In this regard, it should be pointed out that this application, in contrast to Tang et al., does enable a laser surgical system for generating radiation in the 2.9 to

3.0 μm range. This application discloses at page 14 lines 18-20 a type II CPM x-cut KTP crystal with θ = 68-70°, whereas Tang et al. disclose a crystal at θ = 63.4 degrees. Thus, the combination Lin with Tang et al. does not suggest the invention defined by claims 61, 80 and 90. Therefore, the rejections of those claims should be reversed.

4. **New Rejections (pages 3-4 of Office Action):**

Claims 66 and 76 are rejected under 35 USC 103 (a) as being unpatentable over Lin in combination with Tang et al as applied to claims 61 -63, 67-75, 77-80 and 91-96, and further in view of Davenport et al.

The teachings of Lin in view of Tang et al. are discussed above. Davenport et al discloses that increasing the input energy is capable of producing repetition rates in the generic ranges of 5-100 Hz and 20 - 200 Hz (Q-switches), both of which encompass the range recited in claim 76 of the present invention (i.e., pump beam pulses at a rate of ten to fifty hertz). The reference does not suggest selecting the critical range of 10 - 50 Hz. Therefor the rejection should be withdrawn.

As to claim 66, which recites that said pump beam pulse has a diameter on the order of one to five millimeters, Davenport et al. does not appear to even mention beam diameter, and fails to make the selection of one to five millimeters obvious.

Claim 64 (rejected in for the first time in this case) and claim 65 are rejected under 35 USC 103(a) over Lin in combination with Tang et al. as applied to claims 61-63, 65-80, and 85-96, and further in combination with Anthon (a newly applied reference).

Claim 64 recites generating the pump beam as a multi mode beam, while claim 65 recites a multi mode beam having a divergence greater than eight times a diffraction limit of the multi mode beam.

The teachings of Lin in view of Tang et al. are discussed above. Anthon show multi-mode beam used for laser stability in telecommunications applications (i.e., to minimize noise in optical fiber over long distances). Such methods have no bearing on methods of laser surgery as claimed, in which long distances are not a factor. Furthermore there appears to be no discussion of diffraction limits in Anthon. Accordingly, the reference would not have motivate a person of skill in the art to modify the combination of Lin and Tange et al. to arrive at the inventions recited in claims 64 and 65.

Claim 82 is rejected under 35 USC 103(a) over Lin in view of Bosenber et al. This This rejection is not new and was addressed in the Appeal Brief. In support of the rejections, the examiner states that:

> Lin teaches a method as claimed except for the particular non-linear material. Bosenberg et al[.] teach generating wavelength in the range desired by Lin using the non-linear material claimed. It would have been obvious to the artisan of ordinary skill to employ an OPO using the non-linear material of Bosenberg in the method of Lin since this can produce the desired wavelength[, the wavelength] is not critical[, and] provides no unexpected result, and does not manipulatively effect the method, thus producing method as claimed. [Office action page 3 lines 11-17].

Teachings of the cited references alone or in combination do not suggest the invention as claimed in claim 82.

As discussed above, Lin does not enable an OPO laser system for wavelengths in the 2.9 to 3.0 μm range. Lin cites at column 9 lines 41-42 to "Optical Communications, vol. 75, p. 315 (1990) for details on OPO. That paper "report[s] the first demonstration of a tunable mid-IR (1.8 - 2.4 μm) coherent source" (abstract). However, 1.8 - 2.4 μm is outside of the wavelength ranges claimed herein of 2.75-3.0 μm and 2.9-3.0 μm.

Bosenberg et al. does not provide motivation to use an idler beam having a wavelength which is "between about 2.9 and about 3.0 microns" as per claim 82. Bosenberg et al. generically discloses a possibility of achieving a tunning range anywhere between 1.35 and 4.9 μm. While that may be sufficient motivation to experiment, it is insufficient to provide a reasonable expectation of success in either achieving lasing or performing surgery with laser light in the 2.75-3.0 μm range. A reasonable expectation of success is necessary to support obviousness rejection of claims 83 and 84. In re Dow Chemical Corp., 837 F.2d 469, 473 (Fed. Cir. 1988). Moreover, Bosenberg et al. does not disclose a system useful for surgery. Bosenberg et al. does not disclose or recognize the criticality of the specifically claimed wavelength range of 2.75-3.0 and 2.9-3.0 μm for surgical applications. Therefore, Bosenberg et al. does not suggest modifying the system disclosed in Lin.

For the foregoing reasons, the rejection of claim 82 is improper and should be reversed.

Claims 83 and 84 are rejected under 35 USC 103(a) over Lin in view of Rines. This rejection is not new and was addressed in the Appeal Brief. In support of the rejections, the examiner states that:

> Lin teaches a method as claimed except for the pump wavelength. Rines teaches using a Titanium Sapphire laser to pump KTP to produce infrared radiation in NCPM OPO. It would have been obvious to use the of [sic.] OPO of Rines in the method of Lin, since it is not critical, provides no unexpected results, and does not manipulatively affects the method, thus producing the method such as claimed. [Office action page 3 line 19 to page 4 line 2.]

The appellants assert that teachings of the cited references alone or in combination do not suggest the inventions defined by claims 83 or 84.

Contrary to the examiner's assertion, Lin does not "teach a method as claimed except for the pump wavelength". Lin does not enable an OPO laser system for wavelengths of between about 2.9 and about 3.0 microns, or phase matching, as defined by claim 83.

Rines et al. generically discloses generating a pump beam pulse at a wavelength of between about 0.700 and 0.900 microns and converting a fraction of energy in the pump beam pulse into an idler beam pulse having a wavelength of anywhere between about 2.0 and above about 3.0 microns. See figure 9 on page 56 of Rines et al. Rines et al. does not disclose a system useful for surgery. Rines et al. does not disclose the criticality of wavelength for surgical applications. Therefore, there is no motivation to combine the teachings of Rines et al. with the teachings of Lin.

For the foregoing reasons, the rejections of claims 83 and 84 are improper and should be reversed.

Claim 81 is rejected under 35 USC 103(a) over Lin in view of Bosenberg et al. as applied to claim 82 and further in view of Mead et al. This rejection is not new and was addressed in the Appeal Brief.

In support of the rejections, the examiner states that:

> Mead et al[.] teach equivalence of periodically poled LiNbO3 for non-linear wavelength conversion. It would have been obvious to the artisan of ordinary skill to employ periodically poled KTP in the method of Lin and Bosenberg et al[.], since this produces no manipulative effect and it is a recognized equivalent to periodically poled LiNbO3, as taught by Mead et al[.], thus producing a method such as claimed. [Office action page 4 lines 5-9.]

In response, the appellant assert that this rejection is improper and should be traversed for the same reasons discussed in the rejection of claim 82 over the teachings of Lin in combination with Bosenberg et al.

Moreover, the examiner now asserts (OA page 5, paragraph 2) that we argued Lin et al. is

deficient and not enabling, but failed to rebut the presumption that it is enabling, given that the document is a U.S. patent. Presumably the Examiner is referring to remarks on page 9 of the Appeal Brief (Section 3. Lin in view of Tang et al.). However, enablement of subject matter claimed in Lin et al. was not argued. We merely observed that the present application and the prior art both point out that there is an absorption maxima at 2.94 μm in tissue, and that Dr. Telfair indicated that absorption drops sharply outside of the claimed range. He also indicated that the coefficient of absorption of tissue decreases by about an order of magnitude from its peak value at 2.94 as compared to its value above the upper claimed limit of 3.0 μm. Similarly, he indicated that the coefficient of absorption decreases by a factor of 2 from the peak value at 2.94 μm to a value at 2.90 μm, and decreases further as the wavelength decreases.

These are simple statements of fact about the absorbtion properties of tissue. They do address enablement of Lin et al.'s claims. However, one can see from these facts that neither Lin nor Tang et al. provide an enabling disclosure of an OPO laser system that could generate laser radiation at 2.94 or in the 2.90 to 3.0 μm range. Given the extrapolated drop off in power with increasing wavelength suggested by Tang et al., and knowledge in the art of reduced tissue absorption away from 2.94 μm, Tang et al. provided no motivation to use the non-critically phase matched OPO laser as the OPO laser suggested by Lin et al.. Therefore, the rejections of those claims should be reversed.

Respectfully Submitted,

5-1-2008 /RobertHahl#33,893/

DATE

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